CEMENT MILL SECTION of Concrete

The Cement Mill Edition of Concrete is edited exclusively for those interested in the manufacture of portland cement. Its pages are devoted to discussions of plant design, management, operation, production efficiency, chemical research and control, quarry operation, progress and news of the industry.

The Cement Mill Edition also contains all the material published in the corresponding Regular Edition and so provides news of the uses and merchandising of the materials whose manufacture is discussed in the Mill Edition. The Regular Section furnishes mill operating officials and mill executives valuable points of contact with the users of the materials they produce.

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Thermo-Chemistry of Cement Burning

By R. ZOLLINGER

Reduce Heat Consumption per Barrel by Reducing Exit-Gas Temperature—Should Use Waste Heat in Burning Process Rather Than Power Production and Drying—Long Kilns with Low Exit-Gas Temperature Recommended as Best Solution for Wet Process

THIS article is based on the formula for an ideal cement developed by the author in a former paper, viz. $x(3CaO.SiO_2)y(3CaO.R_2O_3)$. Assuming it to be composed of ideal raw materials, viz. the purest kaolin and limestone, this cement molecule is expressed quantitatively by the formula $9.CaO.2SiO_2.1.Al_2O_3$, or $2(3CaO.SiO_2).1.(3CaO.Al_2O_3)$.

It will be assumed that the reaction of cement formation commences at 1,500 deg. C., and that the specific heats of the various materials involved are: CaO 0.1882, SiO_2 0.1887, and Al_2O_3 0.2003.

The following amount of heat will thus be required to raise the cement molecule to 1,500 deg. C.

$$\begin{array}{lrl} 0.1882 \times 9 \times 56.08 \times 1{,}500 = & 142{,}470 & \text{kcal.} \\ 0.1887 \times 2 \times 60.3 \times 1{,}500 = & 34{,}215 & \text{“} \\ 0.2003 \times 102.2 \times 1{,}500 = & 30{,}705 & \text{“} \\ \hline \text{Total} & 207{,}390 & \text{“} \end{array}$$

This heat is held by the cement clinker by virtue of its specific heat, and is conveyed by the clinker to the cooler. It is abstracted from the clinker by the secondary air passing through the cooler and is thus in the main returned to take part in the burning process. The only portion that is lost is the small amount corresponding to the temperature of the clinker on leaving the cooler. This loss depends upon the efficiency of the cooler, and assuming the clinker leaves at 50 deg. C.—a temperature which must be attained with a good cooler—the loss is—

$$727.52 \times 50 \times 0.152 = 5{,}529 \text{ kcal.}$$

727.52 being the weight per kg.-molecule of the cement and 0.152 the specific heat of the clinker calculated from the above data. In practice the loss will be somewhat higher than this, since a certain amount of additional heat is held by the coal ash contained in the clinker. The value 6,000 kcal. may therefore be conveniently taken as the heat lost in the clinker.

From the formula $9CaO.2SiO_2.Al_2O_3$ the weight of a kg.-mol. of cement is 727.52 kg., which corresponds to 1123.52 kg. raw meal, since the 9 molecules of CaO are combined with 9 molecules of CO_2. If 425 kcal. are required to calcine 1 kg. of $CaCO_3$, the heat required to calcine 9 molecules of $CaCO_3$ is $9 \times 100.08 \times 425 = 391{,}730$ kcal.

Heat-Consuming Factors

The actual reaction of cement formation, once the reaction temperature is reached, proceeds exothermically. It thus contributes to the process a quantity of heat of which the exact magnitude has not been established. In practice the value 20,000 kcal. per 1,000 kg. clinker may be taken, which reduces the heat required from the fuel by about 15,000 kcal. per kg.-mol. of cement.

There are, however, further heat-consuming factors involved. First there is the evaporation and superheating to the temperature of the exit gases of a quantity of water depending on the nature of the process; further there is the necessity of heating the CO_2 evolved on calcination to the exit gas temperature; while finally the combustion gases reach the stack at the high exit temperature. Steam, CO_2 and combustion gases together form the entire gases of the process, and their heat content on entering the stack gives the total waste gas loss.

The final loss factor is the radiation from the kiln, etc. This may be taken under normal conditions as 50,000 kcal. for a wet-process kiln and 60,000 kcal. for the dry process. The dry-process figure is higher for the same conditions—i. e., for the same exit-gas temperature in the two processes—because the dry-process kiln must be considerably longer and thus has a greater radiating surface.

Comparison of Wet and Dry Processes

On the basis of these generally valid numerical data, the heat balances for certain examples will be more closely considered. In each instance the calculations refer to a daily output of 150 tons, a figure which may be accepted as normal. Both wet and dry processes are studied, each being subdivided into the two cases in which the waste gases have final temperatures of 300 deg. C. and 100 deg. C. respectively.

There are thus the following four cases:

(1) The dry process with 10 per cent water in the raw meal, the exit-gas temperature not exceeding 300 deg. C.

(2) The dry process with 10 per cent water in the raw meal, the exit-gas temperature not exceeding 100 deg. C.

(3) The wet process with 36 per cent water in the raw meal, the exit-gas temperature not exceeding 300 deg. C.

(4) The wet process with 36 per cent water in the raw meal, the exit-gas temperature not exceeding 100 deg. C.

It will be assumed that the same coal is used in all cases, its percentage analysis being: carbon 80, hydrogen 5, oxygen plus nitrogen 8, sulphur 2, calorific value 7,500 kcal. per kg. (13,500 B.t.u. per lb.). The air requirement of this coal may be calculated as follows::

$$\text{Air} = (2.667C + 8H + H + S)\,\frac{100}{21}$$

$$= 2.62 \times \frac{100}{21} \times 1.2 \times 0.7 = 10.48 \text{ cu. meters per kg. coal.}$$

The figure 1:2 is the excess air factor for normal working.

From *Cement and Cement Manufacture* (London), August, 1932.

The combustion gases occupy the same volume as the air for combustion at the same temperature. Calculating to the exit temperature we find the heat lost in the combustion gases to be—

$$10.48\left(1+\frac{T}{273}\right)\times \text{sp. ht.} \times (T-273),$$

where T is the absolute temperature. Thus in cases (1) and (3) the heat lost in the exit gases per 1 kg. coal is—

$$10.48 \times \frac{573}{273} \times 0.33 \times 300 = 2{,}119 \text{ kcal.}$$

For cases (2) and (4) it is—

$$10.48 \times \frac{373}{273} \times 0.33 \times 100 = 475 \text{ kcal.}$$

Thus the quantities of heat available for cement burning, per kg. of coal used (i. e., per 7,500 kcal. of heat generated), are 5,301 kcal. for cases (1) and (3) and 7,022 kcal. for cases (2) and (4).

Heat is required for evaporating the water and superheating it to the exit-gas temperature. For the evaporation 595 kcal. per kg. of water are required. The superheat factor for superheating to 300 deg. C. is 140 kcal., and for 100 deg. C. it is 46 kcal. Thus the total heat requirement for evaporation and superheating per kg.-mol. cement is—

Case (1) 112.35 (595 + 140) = 82,504 kcal.
" (2) 112.35 (595 + 46) = 71,952 "
" (3) 404.47 (595 + 140) = 297,285 "
" (4) 404.47 (595 + 46) = 258,265 "

The CO_2 from the raw materials must be raised to either 100 or 300 deg. C. Assuming a specific heat of 0.225 for 100 deg. C. and 0.209 for 300 deg. C., the heat required for this amounts to—

Cases (1) and (3) 24,829 kcal. per kg.-mol. cement.
" (2) and (4) 8,910 " " " "

The coal consumption can now be calculated as follows:

Case (1).—391,730 kcal. for calcination.
6,000 " " heat lost in clinker.
60,000 " " radiation loss.
82,504 " " water evaporation and superheating.
24,829 " " heating CO_2.

565,063 " per kg.-mol. cement.

$$=\frac{565{,}063}{5{,}301} = 106.5 \text{ kg. coal} = 14.30 \text{ per cent.}$$

The actual heat supplied is 106.5 × 7,500 + 15,000 (from exothermic reaction) = 813,750 kcal.

Case (2).—391,730 kcal. for calcination.
6,000 " " heat lost in clinker.
60,000 " " radiation loss.
71,952 " " water evaporation and superheating.
8,910 " " heating CO_2.

538,592 " per kg.-mol. cement.

$$=\frac{538{,}592}{7{,}022}\ 77.2 \text{ kg. coal} = 10.65 \text{ per cent.}$$

The actual heat supplied is 77.2 × 7,500 +15,000 (exothermic) = 594,000 kcal.

Case (3).—391,730 kcal. for calcination.
6,000 " " heat lost in clinker.
50,000 " " radiation loss.
297,285 " " water evaporation and superheating.
24,829 " " heating CO_2.

769,844 " per kg.-mol. cement.

$$=\frac{769{,}844}{5{,}301} = 145.0 \text{ kg. coal} = 19.90 \text{ per cent.}$$

The actual heat supplied is 145.0 × 7,500 + 15,000 (exothermic) = 1,102,000 kcal.

Case (4).—391,730 kcal. for calcination.
6,000 " " heat lost in clinker.
50,000 " " radiation loss.
258,265 " " water evaporation and superheating.
8,910 " " heating CO_2.

714,905 " per kg.-mol. cement.

$$=\frac{714{,}905}{7{,}022} = 103.0 \text{ kg. coal} = 13.90 \text{ per cent.}$$

The actual heat supplied is 103.0 × 7,500 + 15,000 (exothermic) = 787,500 kcal.

If the heat of the clinker were not recovered it would in all cases be necessary to add to these figures the 207,390 kcal. necessary to initiate the clinkering reaction, less the 6,000 kcal. entered as lost in the clinker.

Reducing Heat Consumption

Comparison of the foregoing cases shows the superior heat economy of the dry process for equal exit-gas temperatures. In this connection it must not be forgotten, however, that the attainment of equal exit-gas temperatures necessitates a much longer kiln in the dry process.

The greatest possibility of reducing heat consumption lies in reducing the exit-gas temperature. In practice this is limited by the necessity for maintaining a chimney draft corresponding to working conditions. The draft depends on the height of the stack and its relation to the exit-gas temperature. Lower temperatures require a considerably higher stack to give the same draft. It is only rarely that stacks more than 200 ft. in height are built, and stacks of this height require an exit-gas temperature of about 300 deg. C. If it is desired to attain lower temperatures, i. e., lower heat consumption and fuel economy, it is better to utilize the waste gases outside the kiln for drying or raising power. The following calculations show the relationship between exit-gas temperature and height of stack.

The normal draft at the base of the stack may be taken to be $z = 30$ mm. water gauge. The stack height is given by the formula—

$$h = \frac{z}{273\left(\dfrac{1{,}293}{273 + t_{\text{air}}} - \dfrac{1.35}{273 + t_{\text{exit gases}}}\right)}$$

From this formula the height of stack for cases (1)-(4) is: (1) and (3), 300 deg., height = 170 ft.; (2) and (4), 100 deg. height = 410 ft.

The cross-sectional area of the stack is a function of the volume and velocity of the exit gases:

$$\text{Area} = \frac{\text{Gas volume per second}}{\text{Velocity}}$$

$$\text{Vol. per sec.} = \frac{\text{Volume per kg.-mol.} \times 150{,}000}{84{,}000 \times 727.52} \text{ cu. meters.}$$

on the assumption of 150 tons (150,000 kg.) daily output. The cross-sectional area of the stack for cases (1) to (4), assuming the same velocity of 25 meters per second, is as follows:

Case (1): Exit gas per kg.-mol. cement = 3062.4 cu. meters = 76.56 cu. meters per second. Cross-section = 76.56/25 = 3.06 sq. meters (33 sq. ft.).

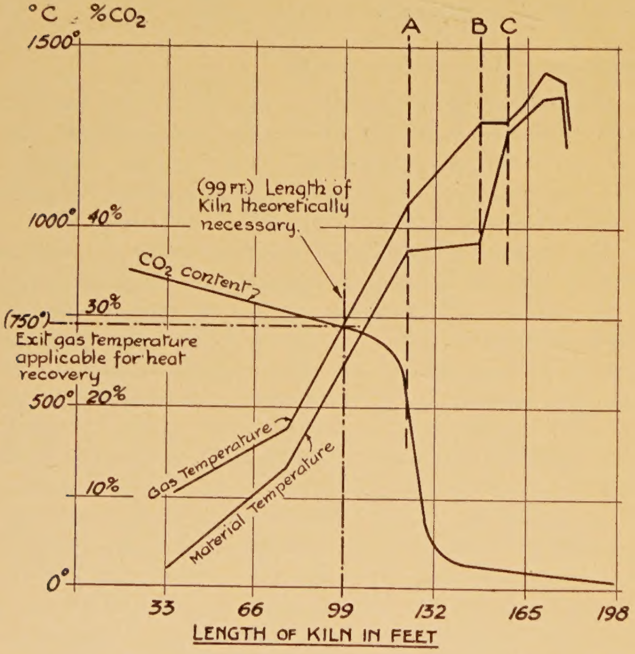
Case (2): Exit gas per kg.-mol. cement = 1564.6 cu. meters = 39.10 cu. meters per second. Cross-section = 39.10/25 = 1.58 sq. meters (17 sq. ft.).

Case (3): Exit gas per kg.-mol. cement = 4672.6 cu. meters = 116.81 cu. meters per second. Cross-section = 116.81/25 = 4.67 sq. meters (50 sq. ft.).

Case (4): Exit gas per kg.-mol. cement = 2425.9 cu. meters = 60.65 cu. meters per second. Cross-section = 60.65/25 = 2.42 sq. meters (26 sq. ft.).

Nacken's Curves of Heat Reaction

It will be interesting to apply the four cases discussed to the construction of the rotary kiln, but certain general questions must first be dealt with. Since fuel and raw material travel in opposite directions in the rotary kiln, the heat exchange is very efficient and there is a continuous fall in temperature along the kiln, the nature of which is illustrated by Nacken's well-known curves in the figure. The combustion gases give up their heat to the raw materials, the temperature of which rises as the gas temperature falls. By including the CO_2 curve in the diagram the conditions in the kiln become readily understood. From the head of the kiln to point *A* we are dealing with pure heat exchange. Between *A* and *B* calcination rapidly proceeds, and the heat consumed is much greater. In this zone the temperature of the raw materials remains almost constant in spite of continuous absorption of heat. Between *B* and *C* the temperature of the kiln gases remains constant. Since the temperature of the raw materials is raised in this zone, we must conclude that heat is given to the gases by the raw materials. In this zone the true process of cement formation takes place, and this is known to be exothermic. The accuracy of Nacken's curves cannot be disputed, since they have been checked and confirmed repeatedly. Although they were obtained by experiment on a rotary kiln 197 ft. long and 10 ft. diameter, they naturally apply, suitably extended or contracted, to all other kilns, including even the shaft kiln.



Nacken's curves of heat reactions in the rotary kiln

The ideal heat exchange is naturally attained when the cross-section of the kiln is completely utilized, as in the shaft kiln. In the rotary kiln only 7 to 15 per cent of the cross-section is utilized, and to attain an economical heat exchange in spite of this the kiln must be correspondingly lengthened. The length depends upon the exit-gas temperature it is desired to obtain. If the dry and wet processes are compared it is obvious that much more water needs to be evaporated in the wet process, and that as a result of this and of the increased fuel consumption necessary to evaporate the water larger volumes of gas are present. Since the heat exchange depends on the gas speed, and the speed upon the kiln cross-section, it follows that the wet-process rotary kiln must have a greater cross-section than the dry-process kiln. On the other hand the increased quantity of gas absorbs correspondingly more heat, so that the Nacken curves for the wet process will fall more steeply as the kiln head is approached. In other words, a shorter wet-process kiln is required if the exit gas temperatures in the two processes are to be equal.

Summary

The various relationships may be summarized as follows. The exit-gas temperature, which is of the first importance to the heat economy of the process, depends on the height and cross-section of the chimney, which are factors of the draft and kiln length. The longer the kiln the lower the exit-gas temperature, but, on the other hand, the greater the initial cost of the plant.

With the same output and exit-gas temperature a shorter kiln of greater cross-section is required for the wet process than for the dry.

The gas velocity depends on the kiln cross-section. On the other hand a change in the cross-section means that a different proportion of it is occupied by the cement materials, assuming the output to be the same. With a smaller cross-section a larger part of the cross-sectional area is utilized than in the case of a kiln of greater section. In order to attain the same conditions of burning in spite of this, the kiln speed must be varied, i. e., a kiln of small section must rotate more slowly than a wider kiln. The rotation of the kiln causes the cement material to roll round and down the kiln, so that if the speed of rotation were the same for kilns of different sections the distance traveled by the material in a narrower kiln would be less than with a wider cylinder, and a shorter time would be spent in the kiln. The heat exchange would thus be less satisfactory in the narrower kiln.

Thus from the purely technical point of view extensive calculations are necessary to decide between the wet and the dry processes. Again the attainment of a low exit-gas temperature is by no means so simple a question as it may appear. Under certain circumstances it may be necessary to avoid the use of long kilns and costly stacks, and to withdraw the exit gases from the kiln at a high temperature and to use them outside the kiln for drying or generating power. The height of the stack may be assisted to a great extent by using forced draft, although in practice there is a definite limit to this.

Should Use Waste Heat in Burning Process

There is no doubt, in general, that it is more correct to use the waste gases so far as possible in the burning process rather than couple the latter with other processes such as drying and power production. The method to be adopted in any particular instance depends on the local conditions, and is a matter for calculation. If it is decided to recover the heat from the gases outside the rotary kiln it is naturally most profitable to keep the kiln as short as possible, i. e., to keep the exit gas temperature as high as possible. The Nacken curves show that temperatures below 750 deg. C. are of no importance in the burning process, so that the gases should be removed from the kiln with a temperature of at least 500 deg. C. in order to insure profitable heat recovery outside the kiln.

Exit gas temperatures of 500 deg. C. can only be attained practically in the dry process, and waste heat recovery outside the kiln is accordingly only applied in this process. The best solution of the wet process problem is the adoption of long kilns with low exit-gas temperatures.

Two National Company Officials Hand in Resignations

Directors of the National Portland Cement Company, Allentown, Pa., are reported to have accepted the resignations of the president and treasurer of the firm on September 30.

The offices were held by Robert H. Anderson, of Ambler, Pa., and Louis Rafetto, respectively.

Rafetto revealed that Anderson and himself had resigned because they realized "how difficult" it would be at this time to sell a new issue of stock. The company is about to float a new issue of its preferred stock, Rafetto is quoted as saying by the *Allentown News*.

"I have no grievances against the company," Rafetto stated. "I stepped out to give someone else an opportunity to take up the project."

Completing Investigation of Cement Industry in Washington

The Federal Trade Commission, Washington, D. C., is bringing to a close its investigation of competitive conditions in the cement industry involving an inquiry as to whether activities of trade associations of manufacturers of cement or of dealers in cement constitute violations of the anti-trust laws.

In addition to the field work, which has been completed, information has been received through questionnaire letters addressed to manufacturers, state highway commissions, dealers, contractors, and ready-mixed concrete companies. The investigational work has been completed. Considerable progress has been made in the preparation of the report.

Fall Plant Reopenings

Four Plants Operate in Birmingham District; Hundreds Find Re-Employment

Fully a half dozen cement plants, feeling the demand stimulated in part by the effect of the Federal Relief Act, reopened or increased their forces during September and October.

In the Birmingham district four mills are now operating. The Alpha plant resumed operations September 23, when 75 men were called back to work. The Lehigh plant started up October 3 after an idleness of several weeks. The 140 men re-employed are now on full time.

Another Lehigh plant, that in Illinois, is to call back 250 former employees early in November after having been idle for a number of months.

Other Middle West plants to reopen are the Louisville Cement plant at Milltown, Indiana, and the Wolverine plant at Quincy, Michigan, re-employing 250 and 100 men, respectively, and both resuming early in October. At least two or three weeks of operation is contemplated at the Fenton, Michigan, plant of the Aetna company which resumed October 8.

Full-time operation was resumed the middle of September after a two months' shutdown at the Bonner Springs, Kansas, plant of the Lone Star company.

A week previous the Cowell, California, plant likewise reopened after having been closed for several months.

Mine Safety Record Made by Cement Industry

"The Alpha Portland Cement Company's mine at Ironton, Ohio, has established a safety record for an underground mine which is probably the best of which we have been able to get information to date," said Dan Harrington, chief engineer of the Safety Division of the U. S. Bureau of Mines, recently, upon being informed of the establishment of a six-consecutive-year safety record by the employees of this mine. The announcement was made through the Bureau of Accident Prevention and Insurance of the Portland Cement Association.

On September 27, 1932, the employees of the Ironton mine had succeeded in operating a total of 2,197 days, or over six years, without a lost-time, partial disability or fatal accident. There was an average of 63 employes for this period, having a man-hour exposure of 569,848.

International Trade Organization Opens New York Offices

New York City offices have been opened by Amerika-Interessen, Inc., organized as the American unit of A. G. Fuer Amerika-Interessen, operating also in Berlin, Paris and London.

The method of operation is to make available to the manufacturers of one country, devices, processes and patents that have been proved successful in other countries, according to Botho Lilienthal, president. Agreements covering production and marketing rights are negotiated for manufacturers seeking business abroad but who cannot export. This is done, Mr. Lilienthal states, by issuing licenses on a royalty basis or by the outright sales of the manufacturing and marketing rights for the country involved.

Lowest Among 28 Industries in Accident Frequency Rate

A report just issued by the National Safety Council, 20 No. Wacker Drive, Chicago, on the accidental injury rates in the cement, mining and quarry industries in 1931, declares that the outstanding feature in the 1931 injury experience of cement companies was the establishment of the lowest frequency rate ever achieved in the industry, the rate standing at 4.86. This rate was also the lowest among 28 major industrial groups. For almost 4,400 organizations in every branch of industry, frequency averaged 15.12, which is about three times the average rate for the 111 reporting cement plants. The progress of the industry in reducing injuries since 1919 is shown in the table. The year-to-year changes are not exactly comparable due to variations in number of reporting units.

NUMBER OF PLANTS, MAN-HOURS, AND INJURY RATES, 1919-1931, CEMENT INDUSTRY

Year	No. of Plants	Man-Hours Worked (Thousands)	Rates	
			Frequency	Severity
1931	111	48,122	4.86	2.80
1930	129	69,729	6.30	2.43
1929	138	75,739	9.54	4.21
1928	136	85,797	10.64	3.75
1927	134	93,871	14.27	2.99
1926	124	97,381	22.30	3.97
1925	120	97,415	26.16	5.02
1924	110	87,767	34.84	5.87
1923	99	76,641	41.71	5.41
1922	94	63,527	40.80	6.50
1921	87	62,247	42.51	6.18
1920	72	59,586	43.89	7.28
1919	67	48,743	43.47	6.70

In severity, the 1931 record of the industry was not quite so favorable. The rate of 2.80 is an increase over the 1930 rate of 2.43, and is far above the average of 1.72 for industry as a whole.

Terminal Additions Planned by Marquette

Application for a permit for further additions to its barge terminal at Peru, Ill., has been made by the Marquette Cement Mfg. Co. The application, which is under consideration at the office of the chief of U. S. Army Engineers, calls for a cement loading bridge and the installation of three clusters of piling.

Exposition of Chemical Industries Set for December, 1933

The Fourteenth Exposition of Chemical Industries is scheduled for the week of December 4, 1933, according to an announcement by Charles F. Roth, manager. Mr. Roth is vice-president of the International Exposition Company, which has organized and directed the presentation of the Chemical Exposition since the first one was held in New York City in 1915. Plans for the next show have been under way for some months, because of previous plans to hold the event early in 1933.

The selection of the later date will bring the exposition at a time coincident with the annual meetings of the American Society of Mechanical Engineers and of the American Society of Refrigerating Engineers, the members of which, it is believed, will welcome the opportunity to attend the exposition.

Iola Plant Makes Six-Year No-Accident Record

The Iola, Kansas, plant of the Lehigh company has just completed a six-year no-accident record, in which no employee has sustained a fatal, partial disability or even a lost-time injury, the National Safety Council has announced.

No cement plant on the American continent has ever succeeded in reaching this record. It covers operations at the quarry as well as in the mill. The record was established September 9.

"The manufacture of cement has always had its share of hazards," said W. H. Cameron, managing director of the Council, "yet for more than four years the cement industry as a whole has led all others reporting to the Council in low accident frequency. The six-year record at Iola offers a new safety mark at which American industry can shoot and proves once again that industrial accidents can be controlled when men make up their minds to do the job."

C. A. Swiggett, superintendent of the plant and chairman of the safety committee, has been swamped with congratulatory telegrams and messages from leaders of the cement industry throughout the country.

Building Up of Business to Occupy Cement Makers' Sessions

Building up of the cement business in 1933 and succeeding years will be the chief subject of discussion during the sessions of the Portland Cement Association annual meeting, to be held in Chicago, November 14, 15 and 16.

Committee meetings are scheduled to open the sessions, which will be held at the Blackstone Hotel. Expanding tonnage will be the subject of the following day, and general business of the third day.

Basing-Point Formula and Cement Prices

The Federal Trade Commission's report, entitled "The Basing-Point Formula and Cement Prices," made public in summary form last March, is expected to be available in printed form about the first of November.

Copies may be obtained by addressing the commission at Washington, D. C.

Laboratory Air Separating Unit Classifies Finer Sizes

Determines Size Distribution Beyond Range of Sieves—Main Features and Operating Procedure of Separating Unit

It is well known that little can be accomplished toward the separation of fine dry particles by means of sieves, when the fineness exceeds that corresponding to the 325-mesh sieve.

Particles just passing the 325-mesh have a diameter of about 43 microns. Present-day portland cement is ground to such fineness that from 75 to 80 per cent of the product will pass the 325-mesh sieve. The mere fact that this percentage of the material passes the 325-mesh provides no indication of the size distribution of the passing particles. Their sizes may be anywhere from 43 microns down to less than 10 microns, or even less than 5 microns. In consequence, in order to know the actual size distribution of the commercial product that is going out from the cement plant day by day, the plant laboratory must determine what portion of the total falls between 30 and 43 microns, the portion between 20 and 30 microns, the portion between 10 and 20, and the portion that is less than 10 microns in size. To supply this information, some other form of separating device must take up the work where the sieves leave off.

Main Features of Separating Unit

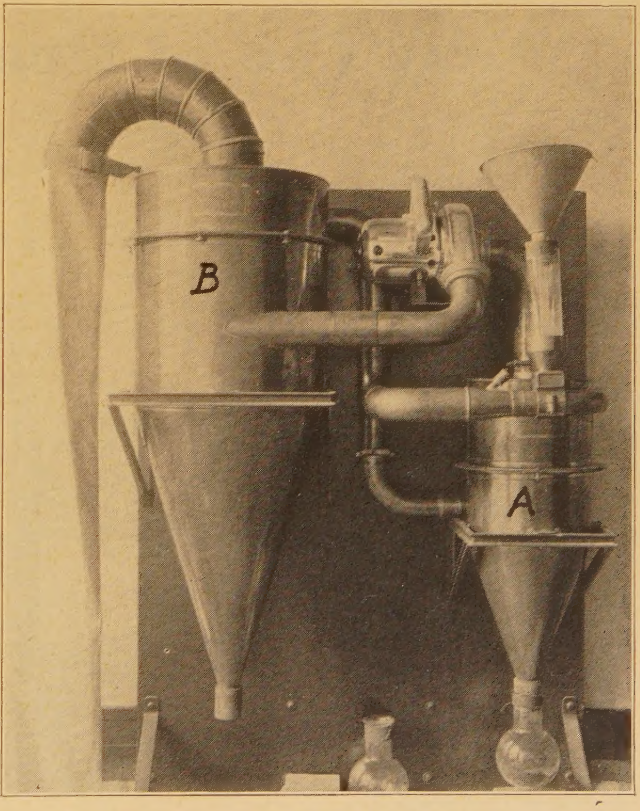
A separating unit often employed for this purpose is shown in the illustration. This is an air separating device which includes among its parts a centrifugal separator and a closed circuit collector, together with a fan and a universal motor operated from a light socket. The separator consists of a head section, a hopper and a cone section, as shown at *A* in the illustration. A tangential air inlet is built into the upper part of the head section and a tangential mesh valve air inlet is applied to the cylindrical part of the cone section.

Closed Circuit Collector

The closed circuit collector, shown at *B* in the illustration, is assembled with a cylindrical section mounted on a long tapered cone section. The cylindrical part of the collector is equipped with a hopper having a drum extension, which divides the cylinder into upper and lower chambers. Air with entrained cement particles is delivered by the fan to the tangential opening below the hopper, and is returned to the system from the upper chamber of the collector through the tangential outlet, being used over and over. Because of the reversed tangential inlet and outlet, high centrifugal velocity is maintained throughout the collector, and the major part of the particles which may escape from the lower to the upper chamber through the hopper drum are thrown out against the shell of the collector and returned to the system. Only the air impounded with the feed escapes under low pressure through the top excess air vent of the collector. An elongated bag, seen at the left of the illustration, is provided for materials lighter than air.

The sample to be separated is introduced into the separator through the hopper by means of a rotary feeder, and with the mesh valve closed, all entrained particles are discharged into a *rejects* flask. When the mesh valve is opened, by means of a dial, the fine particles are drawn out of the separator by the fan, and are delivered to the collector, shown at *B* in the illustration. The quantity and sizes vary with the aperture. Further control is obtained by means of a blast gate which reduces the volume of air handled by the exhauster. For work of high precision, as in the separation of the finer sizes of cement, the mesh valve gate is withdrawn from the air duct and various diaphragms are substituted.

With the use of the diaphragms just mentioned, division of the successive size ranges is made. The range of separation is elastic, since the "key" may be lowered by the operation of the blast gate, and the diaphragms may again be applied to fractionate the material passing through the separator under lower velocity. .



Air separating unit designed for laboratory work

The separator has a diameter of 8 in., and the collector 12 in. Both the separator and the collector are fabricated from 16-oz. copper sheets. The pipe is made from the same material as the separator and collector. The fan and the motor are inclosed in heavy aluminum housing.

The back board on which the unit is mounted measures 31 by 42 in.

Capacity and Power

This separator is capable of handling about 2 lb. of cement or pulverized raw material per minute, from the feed hopper. The fan and motor are direct-connected, and the motor will operate on any 110-volt lighting circuit.

Acknowledgment

The laboratory air separator here described is produced by Federal Pneumatic Systems, Inc., of Chicago, of which W. B. Prouty is president.

Publish Program for Foremen's Safety Conferences

Foremen's Safety Conferences, a new publication issued by the Policyholders Service Bureau of the Metropolitan Life Insurance Company, presents one method which is being used rather extensively to develop safety interest among foremen and others in supervisory positions. The report offers suggested programs for a series of seven conferences to discuss the various phases of safety work, these meetings being presided over by some such representative of the management as the works manager, the general superintendent, or the director of safety. The programs, which are confined to the fundamental principles of safety work as applied to all types of industry, were developed following a review of the activities of a number of industrial organizations in the United States.

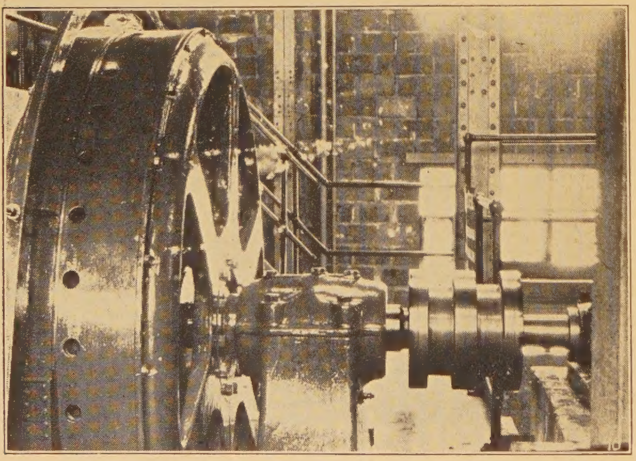
In order to provoke general discussion, a series of nine questions is presented for each of the seven conferences. To aid the conference chairman in determining the scope of each question, the purpose is presented briefly. This is followed by a condensed statement giving general information on the subject, which is intended as a guide to the presiding officer in preparing additional questions and in stimulating discussion whenever it tends to lag.

A limited number of copies of *Foremen's Safety Conferences* are available for distribution to manufacturing executives, safety engineers and others who may be interested in this phase of accident prevention. The report may be obtained by addressing the Policyholders Service Bureau, Metropolitan Life Insurance Company, One Madison Avenue, New York City.

Cement Plants Eliminate Shut-Downs by Use of Proper Couplings

By **FRANCIS A. WESTBROOK, M.E.**
Consulting Engineer, Center Conway, New Hampshire

THE Keystone Portland Cement Company has adopted as standard the flexible, self-aligning type of coupling for all drives to which it is applicable, and in those cases where it has replaced other types of coupling, maintenance costs have been reduced from something like $70.00 a year to less than $3.00 a year per coupling. In addition to this, shut-downs of machinery due to coupling failures have been entirely eliminated. The importance of such performance is obvious when it is considered that cement mill machinery normally runs continuously.



Self-aligning type of coupling on tube mill drive in Virginia cement plant

A Variety of Applications

The drives to which these couplings have been applied vary from the 2-hp. slurry feeders operating at 300-720 r.p.m. to the quarry hoist with a 250-hp. motor running at 575 r.p.m. Other applications are to Fuller-Kinyon pumps, screw conveyors and bucket elevators. The quarry hoist calls for the most severe service in the handling of a car weighing 20 tons when loaded.

Spring type couplings were formerly used in this plant, but were not satisfactory because of the heavy maintenance charges and their liability to failure. The old type required weekly inspections and usually failed twice a year, at least on the Fuller-Kinyon pump drives. The new type of coupling is inspected only twice a year, and so far none of them has failed, the oldest having been in service more than a year. In all, there are 30 such couplings now in service.

Another application is shown in the illustration. This is a tube mill drive at the plant of the Lone Star Cement Company Virginia, Inc., at South Norfolk, Va. It is a 500-hp., 180-r.p.m. drive. The couplings here described are of Bartlett Hayward Company manufacture.

Repair Broken Kiln Tires in Place

Oxy-Acetylene Welding Method Avoids Need of Removing Fractured Tires—Casting Preheated with Oil Burners in Temporary Furnace

The superintendent of the Olympic Portland Cement Company's plant at Bellingham, Wash., recently made use of the oxy-acetylene welding and cutting process to accomplish work which up until that time had been considered possible only by a lengthy and costly procedure. Previously, the replacement of broken tires on the kilns had been a source of considerable trouble. The application of oxwelding to the problem not only materially lessened the time required, but also greatly reduced the cost of this work.

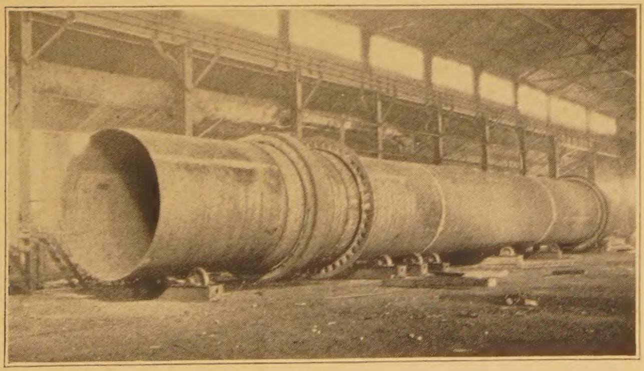
Repairs Broken Tire in Place

Replacement of a broken tire was a troublesome and expensive operation, as it involved, in addition to the cost of a new tire, cutting the kiln in two so that the old tire could be slipped off and the new one put on. The cost usually amounted to about a thousand dollars.

When the superintendent of the Bellingham mill was again faced with this problem, due to the breaking of a tire 36 ft. in circumference and weighing 4 tons, he cast about for some method of avoiding the usual expense. Knowing of the ease with which the oxy-acetylene process could be applied to metal repair, he determined to solve his problem in this manner.

Since the tire had fractured in two places on opposite sides of the kiln, it was necessary to arrange to weld one side one day and the other side the following day.

The first operation was to bevel the edges of the fracture. This was accomplished rapidly with the oxy-acetylene cutting blowpipe. A temporary furnace of brick and asbestos paper was built around the part to be heated, and two oil burners were used to do the preheating. When the casting was at a dull red heat the welding was started. High test steel welding rod was used.



A 120-ft. oxwelded rotary kiln with two cast steel tires

In order to take care of the contraction of the weld metal on cooling, the rivets for about 6 ft. on each side of the fracture were removed by the oxy-acetylene cutting blowpipe, and wedges were driven under the tire to expand it sufficintly to allow for contraction. The tread, or top section of the tire, was welded first, and while this section was red hot the wedges were knocked out. This put the weld in compression. Next the flanges were welded, one welder working on each side from the flange towards the tread. In this manner they were able to keep the right heat across the tire and prevent the development of internal strains. After the weld was completed it was covered with asbestos paper and allowed to cool slowly.

The next day the kiln was rotated and the other fracture repaired in a similar manner. In this way more than seven-eighths of the usual cost of a new tire and installation was saved. The mill superintendent immediately started plans for the reclamation of other kiln tires that had been discarded. Furthermore, the Bellingham plant set a precedent in the cement industry for the new method of reclaiming worn or fractured tires by means of oxwelding.

Fractured kiln tire repaired by oxwelding

A Reminiscence of 1878 and Cobb's Cement

An Iowan Recalls Cement Exhibit of Half Century Ago; C. H. Sonntag Recounts Early History of Cement in New England

In the fall of 1878 the Mechanics' Fair was held at Faneuil Hall, Boston, Mass., and portland cement was one of the products exhibited.

Recollection of the event, coupled with admiration of the scope of the modern product, prompted a letter recently received from an Iowan by the Lawrence Portland Cement Co., Rockland, Maine.

The letter and the reply of Plant Manager Carl H. Sonntag,* are printed below, as taken from the *Rockland* (Me.) *Gazette* of July 28:

The Letter of Inquiry

Dear Sirs:—In October, 1878, it was my privilege to be in Boston, Mass., and attend the Mechanics' Fair in Faneuil Hall, where among other exhibits the portland cement was being advertised. They were giving away boxes which could be used for matches very conveniently, with literature telling of the possibilities of the future of this special cement. This last winter I spent on the Pacific Coast, traveling by auto and bus from Vancouver, in Canada, down into Old Mexico, every inch of the way over cement pavement; and also seeing the tall buildings

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*Author of article, "Maine's First Cement Mill—A Chapter in the History of Portland Cement," October, 1928 issue of *Cement Mill Edition* of CONCRETE.

and the hundreds of bungalows constructed from the same material.

I could not but marvel at the progressive age I had lived in. My story of the growth of the portland cement was interesting and I have told it many times. I take the privilege of writing to you, hoping there is someone left who will appreciate what a wonderful work through cement has been accomplished for the good of humanity. The possibilities have more than reached the ambitions of the promoters of that early day, and I trust they are enjoying the reward that they are justified in receiving.

(MRS.) MARY E. STEARNS.

Plant Manager Sonntag's Reply

Dear Mrs. Stearns:—

The letter that you addressed some time ago to the Portland Cement Company, Portland, Maine, was eventually forwarded to us here, as there is no Portland Cement Co. in Portland, and we are the only manufacturers of this commodity in New England.

The cement that you saw on exhibition in Boston in 1878 was undoubtedly made in Rockland, about three miles from Thomaston. Although it was a true portland cement, it was made by the Cobb Lime Company of Rockland, who at that time were the largest producers of lime in this country. They started the manufacture of cement in order to use up certain stone from their quarries that was not suitable for lime making, although it was an excellent raw material for cement. I have on my desk a paper weight made at that time from that cement that is in as good condition as the day it was made. There is a cellar floor in one of the business buildings in Rockland that was laid at that time, and there are several dams for country saw mills in this neighborhood that were built of this cement and are still doing the work for which they were built.

Unfortunately, soon after this old plant was started the importation of cement from England began, and although the local product was of excellent quality it could not compete in price with the imported article, so that manufacture was discontinued after less than three years of operation. The old kilns are still standing, and the land on which they are is now owned by this company. The machinery was dismantled many years ago.

As a student of the history of cement making in America I have been interested in this old plant. About three years ago while prowling about the old kilns, which are on the water front, I found some of the material that had been burned in the kilns but had been thrown out without further treatment. It had lain in the open, exposed to the weather and to tide water for over fifty years, but when I brought it to our laboratory and ground it up, it turned out to be nearly as good cement as is made today. This is certainly an excellent testimonial to the quality of the product that was turned out so long ago, when but little was really known about making or using cement.

The Cobb Lime Company was owned by Francis Cobb, who was the father of ex-Governor William T. Cobb of Maine. Governor Cobb is still living in Rockland, but he was a student in Heidelburg University in Germany in 1878-79, and so was not directly connected with the operation of the old plant. He was intensely interested in your letter when I showed it to him, for he likes to speak of the days when Rockland lime was shipped all over the eastern part of the United States and even to Gulf of Mexico ports. It was all sent out in sailing vessels, and he recalled that a Captain Stearns was at one time in command of one of their ships, though of course he did not know that either you or Mr. Stearns had ever lived in Rockland.

Your recollection after so long a time of what you saw at the Mechanics' Fair in Boston is an excellent example of the value of advertising properly done, and it was very kind of you to write as you did. We thank you sincerely for having done so.

C. H. SONNTAG, *Plant Manager.*

North American Wins Annual Quarry Safety Award

The 1931 safety record of the Martinsburg, Va., quarry 5 and 6 of the North American Cement Corp., won for it the *Explosives Engineer* award, in competition with other members of the National Crushed Stone Association.

The Martinsburg quarry won the bronze plaque presented annually by the *Explosives Engineer* magazine by operating 115,403 man-hours without a lost-time accident.

The other fifteen quarries, all of which received honorable mention, worked fewer man-hours.

Change of Address for British Association Office

The British Portland Cement Association, Ltd., announces that its midland office has been removed to "Dimminsdale," Willenhall, near Wolverhampton.

PERSONALS

Harry Lewis, 43 years old, an employee at the Iola, Kans., plant of the Lehigh company, passed away on September 27 as the result of a cerebral hemorrhage.

John W. Dickinson, for many years connected with the sales department of the Marquette company, and a brother of Theodore Dickinson, president of the firm, was killed in an automobile accident on the West Coast, according to advices received at La Salle, Ill., on September 26.

Major J. C. Shumberger, comptroller of the Lehigh Portland Cement Co., was elected among the first twenty-one directors of the newly organized Comptrollers' Institute of America, at a meeting in the Hotel Roosevelt, New York City, on September 19.

Major Shumberger's honor came after his reading a paper on the "Responsibilities and Rank of the Comptroller," in which he declared that the depression has turned the spotlight on the comptrollers and that the burden of keeping business on an even keel has been shifted in very large part to these officers.

John J. Porter has been elected president of the North American Cement Corp., succeeding the late Frederick Williams Kelley.

Mr. Porter has been vice-president and general manager of the corporation since its organization. His headquarters will be at 285 Madison Avenue, New York City, an announcement dated September 28 and issued by the company, states.

EDITORIAL

Rehabilitate a Part of Your Plant

THE Committee on Industrial Rehabilitation, headed by A. W. Robertson, chairman of the board of Westinghouse Electric and Manufacturing Company, is making genuine progress in its vigorous efforts to promote industrial rehabilitation through the replacement of obsolete mechanical equipment.

One of the most constructive points put forward by Mr. Robertson and his co-workers is the insistence that only enough new equipment be installed to provide for the same production as the old equipment which has been replaced and scrapped. The purpose in this admonition is that of preventing the useless increase of capacity.

Another point of equal importance, one that carries particular significance for the cement industry, is that immediate replacements of obsolete equipment should cover only the expected production for the coming year.

Suppose, for illustration, that a certain cement plant has a total installation of five kilns, with an annual capacity of 2,500,000 barrels, and that expected production in the coming year is 40 per cent of that capacity, or 1,000,000 barrels, as an outside estimate. Suppose, also, that the equipment throughout the entire plant, including the kilns, is obsolete and that unit production costs are considerably higher than in modernized plants.

What the Robertson committee is urging in a situation of the kind just outlined—and there are many of them in the cement industry—is that two of the five kilns, and all accessory equipment employed in keeping these two kilns in operation, be replaced with the most modern equipment available. In this way, and only in this way, can the unit cost of production be brought down to where it should be.

The remaining three kilns and their accessory equipment should be put out of operation as soon as the new installation is completed, and should either be scrapped at once or at a later date, when increased production requires their replacement. They should never again be used for the manufacture of cement.

The soundness of this plan for rehabilitating obsolete plants in part lies in the undeniable fact that great strides have been made during the past three years in the design of cement-making equipment. Because of the reduced production cost made possible by the new machinery and the new processes, plants that modernize their facilities to the extent of their probable production requirements for 1933 will be able to make a profit at present price levels. Plants that are not modernized cannot hope to operate at a profit unless further price advances occur—and who can afford to gamble on that?

Now that equipment can be bought and installed at a cost far below normal, the months immediately ahead of us are the time for action.

Where Can the Funds Be Obtained?

A RECENT interview with an official of a cement plant, in which the Robertson committee's plan for industrial rehabilitation was under discussion, drew out the very natural question as to how or where the necessary funds may be obtained.

In a general sense it may be said that the cement plants which are most in need of rehabilitation are in the poorest cash position. That is the most direct cause of the obsolete condition of their equipment and processes.

One possible source of funds is suggested in the assertion in another editorial on this page, to the effect that plants which modernize their facilities to the extent of their probable production requirements for 1933 will be able to operate at a profit at present price levels. Here is the story that may interest the banker. If he can be convinced that this deduction is correct, he may be willing to advance the necessary funds to finance the replacement, at least until improved conditions permit refunding of the loan through the sale of stock.

Another financing plan suggested by the Robertson committee involves the sale of preferred stock, though for the present it is believed that the short-term bank loan offers the most practicable channel.

For some months bankers have contended that they are willing to make sound industrial loans; but prospective borrowers have met with considerable difficulty in the negotiation of such loans. This suggests the advisability of first enlisting the aid and co-operation of members of the Federal Reserve district committee or one of its sub-committees, all of which are a part of the organization set up by the Robertson committee.

Regardless of what method may be employed to raise the necessary funds, owners of old plants must realize that obsolescence is one of the worst forms of waste, and that this waste must in some way be eliminated.

New Cooling System Is Feature of Plant Extension

Oil-Fired Rotary Kiln, New Tube Mills and Waste Heat Recovery System Are Other Installations Added to Step Up Output in Cement Plant in Orient

A NEW rotary kiln equipped with a cooling system that constitutes a new departure in this direction, new tube mills at the raw and finish ends, and a waste heat recovery system, are the major installations recently completed in a wet-process cement plant in the Orient.

Demand Greater Than Expected

These installations were made as a means of increasing the output, since the high quality of the cement produced had developed a demand beyond the amount estimated when the original plant was built several years ago.

The rotary kiln is 9 ft. and 9 ft. 6 in. in diameter and 223 ft. long. The tube mills are compartment types, each 7 ft. 3 in. in diameter and 42 ft. 8 in. long.

In conjunction with the kiln there was also installed a waste heat steam raising plant with turbine, thereby providing the works with cheap electric current.

New Departure in Cooling

In regard to the provision for cooling the burnt clinker, the rotary kiln (Figure 1) involves a new departure. It carries at its discharge end, where the diameter is 9 ft. 10 in., twelve cooling cylinders of 35 in. diameter, uniformly spaced around its circumference. The arrangement of the cooling cylinders and the method of support result in low headroom requirements and insure dependable working. Through such a subdivision of the cooler, separate small cooling chambers (Figure 2) are formed, so that the combustion air flowing to the kiln through the 12 cooling cylinders comes into such effective contact with the hot clinker that the latter is very efficiently cooled and the combustion air enters the kiln at a high temperature. Another source of increased cooling effect lies in the fact that the clinker travels in the cooling cylinders in the opposite direction to its progress in the kiln and hence is exposed to the cooling air for a long period. In Figure 3 the path of the cooling air (A) and of the clinker (B) in the kiln and in the cooling cylinders can be seen. The temperature of the clinker on leaving the cooler, with a daily kiln output of approximately 200 tons, is about 100 deg. C.

Lining Provided with Scoops

The cooling cylinders are protected from wear, and radiation losses are minimized, by a lining that is provided with strong scoops for lifting and dropping the clinker. At the points where the clinker leaves the kiln for the coolers the clinker is spread out by cooling pieces fitted in the kiln, and thereby undergoes a preliminary cooling. These cooling pieces are made of special heat-resisting steel, which retains great hardness even at high temperatures. Through the cooling cylinders there is passing 90 per cent of the total combustion air.

The fuel oil for firing the kiln is preheated to approxi-

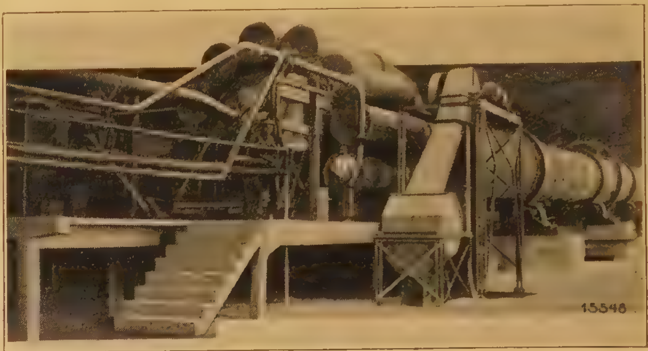


Figure 1. Twelve cylinders around discharge end of kiln constitute new departure in clinker cooling

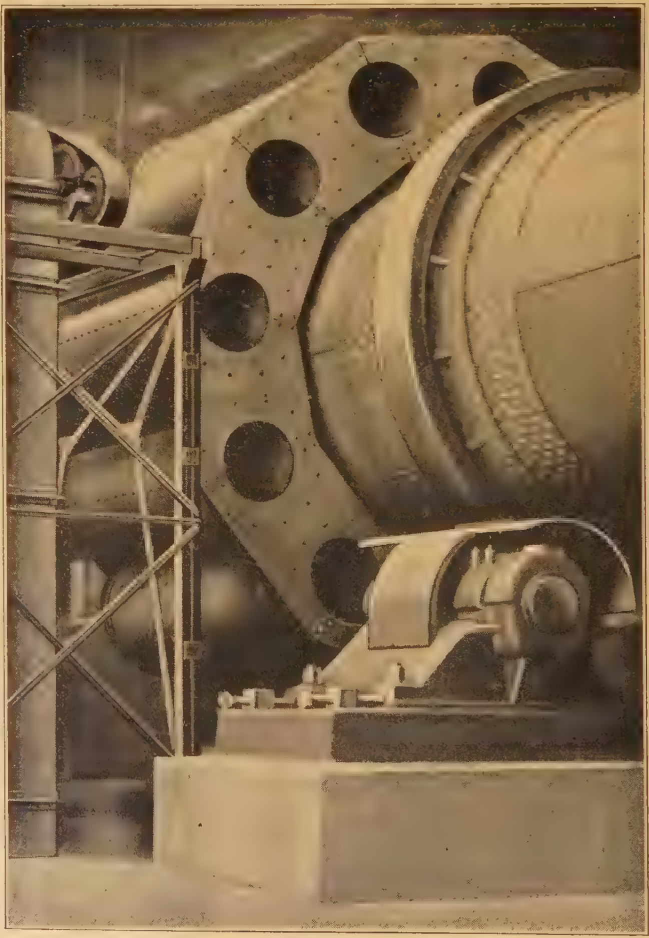


Figure 2. Combustion air enters kiln through 12 small cooling chambers

mately 120 deg. C. and is atomized in the kiln through a specially designed nozzle, employing air at 15 lb. per sq. in. excess pressure. As a protection against the radiant heat of the hot clinker, the pipes supplying the oil and the air blast are run inside a larger pipe, through which air is fed under pressure to the jet of atomized oil. At the same time this results in the oil being burnt some distance off the nozzle instead of directly at the latter.

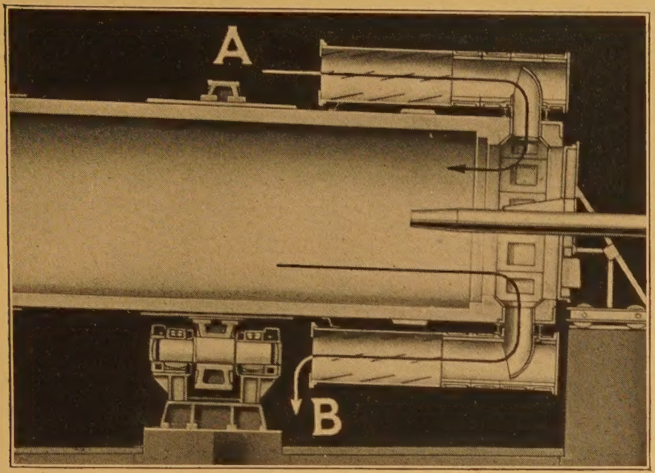


Figure 3. Diagram showing path of cooling air (A) and of the clinker (B)

A feature that has proved particularly helpful in the control of the working is that the new cooling arrangements of the kiln involve no shifting of the sintering zone farther up the kiln, and the flame can therefore be effectually observed from the burner control platform.

Kiln Angle

The kiln is pitched at an inclination of 3 per cent (0.36 in. to the foot). It is driven by a 35-h.p. electric motor by means of enclosed gearing and makes one turn in 40 seconds. There results a brisk turning over of the material in the kiln and a favorable transfer of heat from the hot gases to the charge. An overthrowing device at the feed end of the kiln brings about accelerated evaporation of the water contained in the slurry.

Of the two new tube mills, which are driven by a coupling spindle attached centrally to the grinding drum, the raw mill gives an average performance of 110 lb. per h.p. In this mill a fineness is obtained of 6 per cent residue on the German standard sieve "DIN 70" (4,900 meshes per sq. cm. = approx. 180-mesh American sieve), based upon dry material and a water content of the slurry of 35 per cent. It should be added that the raw materials contain a large proportion of sandy constituents, difficult to grind.

Tube Mill Output

The tube mill at the finish end has an average output of about 88 lb. per h.p. on sharply burned rotary kiln clinker, giving a fineness of 8 per cent residue on the "DIN 70" sieve.

Altogether, for the newly supplied mechanical equipment an output of 185 tons per day was laid down. Within a short while of starting up, however, the average output had reached 200 to 210 tons daily.

The equipment here described is known as "Concentra" equipment, supplied and installed by the Fried. Krupp Grusonwerk A. G., Magdeburg, Germany.

Bauxite Cement of High Quality Made in Poland

Rapid Hardening, Impermeable, and Resists Acids —Hardens During Cold Weather

Bauxite cements have been in use in Poland for 10 years or more. Their advantage is found in their chemical composition, the fact that not the lime or the silica, but the Al_2O_3 component, constitutes the principal element, according to an article in the July (1932) issue of *Revue des Materiaux de Construction* (Paris).

Poland, which formerly imported considerable quantities of bauxite cement, commenced its production in 1931. It was the Electro establishment, at Laziska, in Upper Silesia, which launched this product under the name of "Alka-Electro" cement.

Rapid Hardening Process

Tests made in leading laboratories of Poland and in other countries seem to prove that the Polish product is of good quality. Experience has proved that while the time of set is somewhat slow, requiring 2 to 3 hours, the hardening process is very rapid. After 12 hours the cement is hard, and at the age of 24 hours it offers a resistance, in compression, of 8,530 lb. per sq. in. Ordinary portland cement, of course, requires a period of 3 to 4 weeks to attain an equal degree of strength.

This very rapid hardening permits the removal of forms after 24 hours, and even after 12 hours if any object is to be gained in doing so.

Hardens in Zero Weather

During the hardening process the bauxite cement develops heat, which activates the process even during cold weather. Construction work has been successfully accomplished in temperatures ranging from 5 deg. above zero F. to 4 deg. below.

STRENGTH OF 1:3 MORTAR, IN LB. PER SQ. IN.

TENSILE STRENGTH

	Age at time of test				
Test No.	1 day	2 days	3 days	7 days	28 days
1	597	529	583	603	794
2	558	612	526	623	717
3	597	563	592	597	708
4	481	626	643	572	785
5	540	563	620	586	748
6	549	572	583	600	686
Average	553	577	592	600	728
COMPRESSIVE STRENGTH					
1	7,567	8,648	8,562	8,932	11,464
2	7,624	8,875	8,648	9,928	10,298
3	7,709	8,363	8,904	9,245	11,095
4	7,254	8,790	9,103	9,643	10,410
5	7,055	8,989	9,274	9,188	11,407
6	8,136	8,619	8,818	9,757	11,464
Avge.	7,571	8,713	8,885	9,448	11,023

The impermeability of bauxite cement has been demonstrated even in cases where it was subjected to high pressures. In addition, it has been found to be absolutely resistant to the influence of acids.

When stored in a warehouse under the usual conditions, this bauxite cement has shown itself resistant to the influence of moisture and acids.

The manufacturer has had a number of tension and compression tests conducted, from which the results shown in the table have been obtained.

Big Variation in Temperature Rise of Fifty Cements

According to tests being conducted by the U. S. Bureau of Standards, the rise of temperature of 50 different cements in the form of pastes showed that there was a marked difference in the cements in this respect. The conditions under which the hardening took place were empirical but easily reproducible, and hence the data can be readily compared. The temperature rose during the first 24 hours from 21 deg. C. to as much as 90 deg. C.; the average rise was approximately 40 deg. C. and the minimum 15 deg. C.

While the chemical analyses showed that there was a general relation between the constitution and the temperature rise, there were rather numerous deviations from the general trend. The higher tricalcium silicate contents produced the higher temperature rise as a rule, but the minimum rise obtained was produced by a cement having 51 per cent of this constituent, which would have been expected to have produced a rise well towards the maximum obtained.

The fineness of grinding and the presence of moisture very materially affected the rate of rise. The effect of the former was determined by obtaining the rise of pastes made from the cements composed of 50 per cent of the sample as received and 50 per cent retained on a No. 325 sieve. In many cases the maximum rise was reduced about one-half. The introduction of 4 per cent water into the samples as steam while the sample was at 105 deg. C. produced also about a 50 per cent less temperature rise.

To study this question further, adiabatic calorimeters have been constructed in which fifteen 6- by 12-in. concrete cylinders can be stored at the same temperature as that which they will develop in their interior during hardening.

Reduce Accidents from Blasting Caps

During the first six months of 1932 there was a decrease of 53 per cent in blasting cap accidents to children as compared with the number reported during the same period of 1931, according to figures compiled by the Institute of Makers of Explosives.

In the hope of still further reducing the accidents, the Institute has enlisted the support of superintendents of public instruction in the various states, their teachers, the Department of Agriculture, the Bureau of Mines, at Washington, Boy Scouts and Girl Scouts, and safety organizations of various states. A special plea is made to all users of explosives to see that blasting caps are kept out of the reach of children.

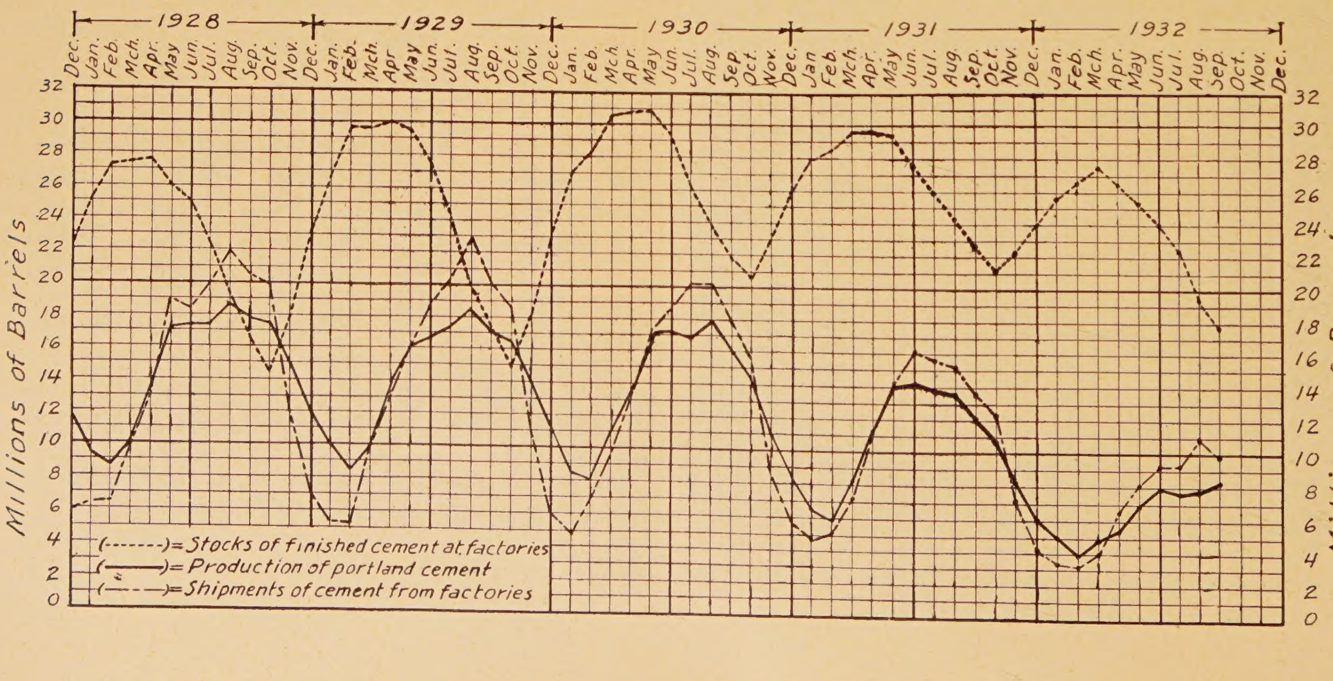
Cement Statistics for September

Relation of Production to Capacity

	The Month	Twelve Months
September, 1932	36.9	30.6
September, 1931	55.3	50.2
August, 1932	34.2	32.1
July, 1932	33.4	34.2
July, 1932	35.7	36.5

Production, Shipments and Stocks of Finished Portland Cement (In Barrels)

	1931	1932
Production, September	12,092,000	8,189,000
Shipments, September	13,671,000	9,722,000
Stocks at end of month	22,736,000	17,865,000
Production for year to date	99,673,000	57,839,000
Shipments for year to date	102,807,000	83,939,000



Mill Equipment

New Brookville Locomotive Series in All Gauges Is Launched

The Brookville Locomotive Co., of Brookville, Pa., have recently announced their new "B-I-30" series, supplied standard in all gauges, in 4, 5, 6 and 7 tons weight. They are strictly a quality product, with every essential part, but no inessentials. Speed range, both forward and reverse, is from 2 to 15 miles per hour, with engine power far above the average used in locomotives of this weight, it is stated. Power unit is the new "I-30" McCormick-Deering industrial tractor. Locomotive features have been held to essentials, including a heavy unbreakable steel frame, sanders, dual brakes, dual spring journal boxes, etc. The well known Brookville steel tired drive wheels are standard equipment.

Bulletin B-29, fully describing and illustrating this locomotive series, may be had upon request.

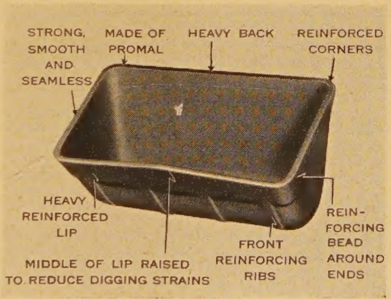
Wide Power Range Is Feature of Improved Vertical Gas Engines

An improved line of vertical four-cycle gas engines, covering an unusually wide power range in a variety of cylinder combinations, recently has been announced by the Worthington Pump and Machinery Corp., Harrison, N. J. These units are built with one to eight cylinders and 30 to 150 h.p. per cylinder, thus meeting all power requirements from 30 to 1800 h.p. Due to the ever-expanding territory in which gas—both natural and manufactured—is available at low cost, these engines should find wide application as prime movers in a wide range of industries. The fact that they can be converted to diesel operation makes them additionally attractive.

Many unusual details of construction are incorporated in these engines, among them being: A mixing valve, common to all cylinders and adjustable through a single knurled handscrew, is employed on all but the largest units. Separate air and gas mixing valves—independently adjustable for each cylinder—are installed in each cylinder head of the largest engines. In all but the smallest units, air inlet and exhaust valves are carried in removable and interchangeable cages, the exhaust valve cages being water cooled; in the smaller engines, these valves (also interchangeable and adjustable) seat directly in the cylinder head and operate in removable bushings.

New Elevator Bucket Is Announced by Link-Belt

A new design of elevator bucket for heavy-duty work, said to be the first notable improvement in cast bucket design over a period of years, is announced by Link-Belt Co., Indianapolis, the last innovation having been the appearance of reinforced lips and reinforced backs.


STRONG, SMOOTH AND SEAMLESS
MADE OF PROMAL
HEAVY BACK
REINFORCED CORNERS
HEAVY REINFORCED LIP
MIDDLE OF LIP RAISED TO REDUCE DIGGING STRAINS
FRONT REINFORCING RIBS
REIN-FORCING BEAD AROUND ENDS

The new bucket, to be known as Style "AAP" is made in all the popular sizes, such as 8 by 5, 10 by 6, 12 by 7, 14 by 7, 16 by 8 and 18 by 8, and its principal features are summarized as follows:

1. Heavy back.
2. Heavy lip.
3. Reinforced corners.
4. Front reinforcing ribs.
5. Reinforcing bead around ends.
6. Middle of lip raised to reduce digging strains.
7. Made of Promal—the new, stronger, long-wearing metal.

The company states that the "AAP" bucket embodies ideas gained from users of buckets in many fields, as well as an improvement in its foundry department in the method of pouring buckets, resulting in sounder castings than was possible with the old method.

Horizontal Steam Pumps Incorporate Unusual Features

An improved line of horizontal duplex steam pumps, especially designed and fitted for handling either water or chemical solutions, recently has been announced by the Worthington Pump and Machinery Corp., Harrison, N. J. Built in three different types—valve plate, turret and pot valve—these units incorporate many revolutionary features which, it is said, represent the greatest forward steps in steam pump construction in recent years. Foremost among these features is the adoption of stainless steel drop forged valve service on all models.

The valve plate type pumps have the discharge valves screwed into a common removable deck. These units are of the submerged piston type with all suction and discharge valves above the cylinders. Valve service is of the disc type, and all pumps have the standard duplex steam end.

For transfer, tank, circulating, boiler feed and water supply service, units of this group are standard fitted and have forced-in liners and screwed stuffing boxes.

Turret type pumps have the suction and discharge valve decks cast integral with the cylinders, are of the submerged piston design and have disc type valve service. Suction valves are accessible through handhole plates and discharge valves through the top cover. Stuffing boxes are of the bolted type with bolted glands.

Standard fitted (with forced-in cylinders) for all water service and all-iron fitted (with removable NiResist liners) for handling caustic solutions, turret type pumps are available for capacities of 150 to 840 g.p.m. for discharge pressures to 75 lb. per sq. in. and with capacities of 100 to 500 g.p.m. for pressures up to 200 lb. per sq. in.

Pumps of the pot valve pattern, all with submerged pistons, come in three types: For pressures up to 500 lb. per sq. in. with a capacity of 40 to 96 g.p.m. they have a special steam end with suction valves accessible through discharge valve seats. Stuffing box glands are bolted, piston rods are divided, cylinder liners are removable and valve service is of the poppet type.

New Line of Fluid Meters Announced by Bailey Co.

The manufacture of a new line of fluid meters for the measurement of steam, water, gases, and other fluids has been announced by the Bailey Meter Co., Cleveland, Ohio. The new meters combine the qualities of high accuracy and dependability under severe service with a price which is in accordance with 1932 conditions, it is stated.

Three general combinations of meters are available; indicating and integrating; recording and integrating; indicating, recording, and integrating. The record is made on a 12-in. diameter, 24-hr. chart. Accurate analysis of the record is equally easy throughout the entire flow range since the flow graduations are uniformly spaced. This feature also greatly facilitates comparison with records of presssure and temperature which may be obtained on the same chart, when desired, by incorporating auxiliary recorders in the flow meter casing. The total flow is given in pounds, gallons or other units by a 6-unit counter which is located behind a small window in the meter name plate. This may be read as easily as an automobile mileage register.

The construction of the meter is very simple. The flow mechanism is operated by the difference in pressure produced between the inlet side and the outlet side of the orifice or other primary element inserted in the pipe line. The inlet, or higher pressure, is connected to the interior of the mercury sealed Ledoux Bell, and the outlet or lower pressure is applied to the exterior of the bell. The bell responds to changes in the differential pres-

With the Manufacturers

Industrial Literature

Traylor Crusher

The Traylor Engineering and Mfg. Co., Allentown, Pa., has recently issued *Bulletin 111*, on the Type BH gyratory crusher.

The features of the unit as outlined are as follows, in part: A straight line, bar type non-weaving spider; a self-tightening, auto-locking and non-stripping suspension nut; a stocky, non-deflecting main shaft; an extremely long eccentric, and cast steel gearing with accurately machine cut teeth.

New Steel Chain Book

An illustrated 144-page catalog has just been completed by *Link-Belt Co.*, on steel chains, in which information on the older chains is brought up to date, and many new and useful sizes are offered for the first time.

The sizes range from the small detachable steel Link-Belt (No. 25 size) having an ultimate strength of 950 lbs., to powerful chains of as great a strength as 1,500,000 lbs. Between these two extremes the specifications, dimensions, strengths and list prices of a large number and variety of chains are given, suited to practically every elevating, conveying and power transmitting service for which steel chains can advantageously be used.

Many attachment links are illustrated for elevating and conveying work; and a comprehensive line of sprocket wheels has been included, enabling the user to select suitable sizes of sprockets for the work to be done. A word of caution is embodied in the book's foreword, to the effect that chain life depends upon the sprocket wheels, as to insure durability and maximum service of both chain and wheels they must fit each other properly.

A copy of the new book, *No. 1192*, may be had by addressing Link-Belt Co., Indianapolis, Ind.

Explosives Engineer

The October issue of the *Explosives Engineer*, published by the *Hercules Powder Co.*, Wilmington, Del., contains, in part, an article on the opening of a new quarry in the East, editorial reference to timely quarry matters and another lecture of a series in a study course.

Oxy-Acetylene Publication

A lengthy article on General Maintenance occupies a major portion of the October issue of *Oxy-Acetylene Tips*, published by the *Linde Air Products Co.*, New York City.

The contents also include items on the identification of metals by simple tests and on new oxy-acetylene developments.

Crusher Bulletin

Superior-McCully crushers are described in *Bulletin 1472*, newly issued by the *Allis-Chalmers Manufacturing Co.*, Milwaukee, Wis.

Points of superiority stressed are the rigidity of the spider hub, strength of main shaft, type of dust collar, efficiency of oil pump, area of eccentric, gear construction, main frame machining, and maintenance cost.

FIELD ACTIVITIES

Ingersoll-Rand to Sell SKF Drill Steel

Arrangements have been made whereby *Ingersoll-Rand Co.*, New York City, has acquired exclusive rights to market SKF drill steel throughout the world. The product is being sold under the trade name *IR-SKF*.

This brand of steel, which is claimed to be of unusually high quality, was developed as a result of exhaustive tests and experiments by the technical departments of Ingersoll-Rand Co., in collaboration with the SKF mills.

The high power and fast speeds of modern rock drills require a high quality drill steel with long fatigue life to resist breakage and to give fast cutting power. It is said that IR-SKF steel meets these requirements and that at the same time it is easy to shape and sharpen and that it will hold its cutting edge and gauge through a long period of service.

IR-SKF steel is available for immediate delivery in all standard sizes and sections in both solid and hollow forms. The hollow steel is made by the SKF "supersmooth" hole process, which is claimed to produce an absolutely uniform hole throughout the length of the steel.

Jeffrey Office Moved

The Jeffrey Manufacturing Co., Columbus, Ohio, announces the removal of its southwestern branch office from Houston to Dallas, Texas.

Mr. T. P. Burke continues as manager.

LeFevre Joins Heisler

Harvey LeFevre, formerly sales manager of the *H. K. Porter Co.*, has joined the forces of the *Heisler Locomotive Works*, Erie, Pa.